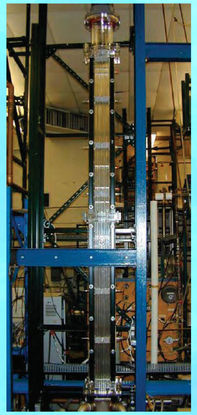
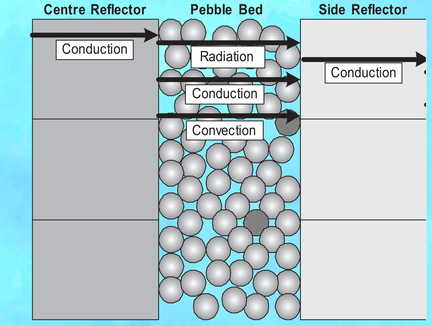
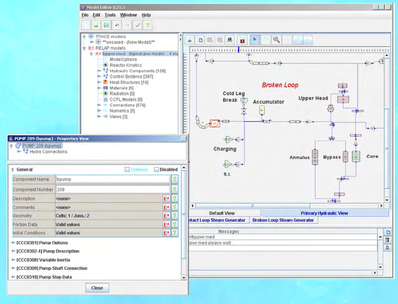
Forward-Looking and Long-Term Research in Methods Development



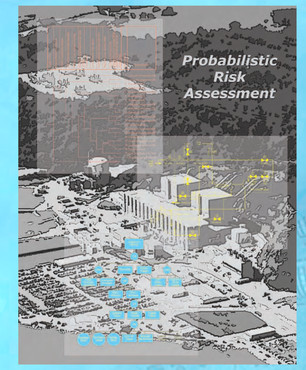
Heat Transfer Rod Bundle



Pebble Bed Schematic



Creating Input Models Using SNAP



Advanced PRA Schematic

Forward-Looking Research is identified, as a matter of routine, as long-term research activities supporting potential longer term (within the next few years) regulatory needs. There are several projects in human and materials performance presently underway.

The seismological community has come to a consensus that the baseline **probabilistic seismic hazard assessments** for the central and eastern United States (CEUS) completed in 1989 need update. The first update project will develop a tectonic framework for the CEUS, identifying seismic source zones, the maximum magnitude of events in the zones, and their rates for occurrence of earthquakes. The second project will collect, analyze, and synthesize all the publically available ground motion data for the CEUS.

There are no consensus methods for quantifying the reliability of digital systems for incorporation in **digital system probabilistic risk assessments (PRA)**. This research develops methods, analytical tools, and regulatory guidance to support nuclear power plant licensing decisions and digital systems PRAs. A specific area that is currently being pursued is the quantification of software reliability.

NRC has **cooperative agreements for risk assessment**. One agreement with the University of Maryland will capture uncertainties in fire modeling and develop data inference methods for human reliability analysis. Two cooperative agreements with the Massachusetts Institute of Technology address the development of methods for quantification of uncertainties in passive system performance modeling and advanced uncertainty and sensitivity methods. This latter effort is focused on sensitivity and uncertainty methods as they may be used in simulation-based systems analysis.

NRC entered into a memorandum of understanding (MOU) with the National Aeronautics and Space Administration to expedite the development of **risk and reliability analysis methods, tools, data, and applications** and to avoid unnecessary duplication of research tasks between agencies. The MOU facilitates the development of advanced risk and reliability analysis techniques, new generation risk-analysis software, software reliability analysis, reliability data collection and analysis, human performance and reliability data collection and analysis, accident precursor analysis, risk-informed decisionmaking techniques, uncertainty and safety-margin analyses, risk-analysis applications in design processes, and fire-risk analysis.

Rod Bundle Heat Transfer (RBHT) Facility at Penn State is a long-term project to develop advanced models and correlations for future fuel bundle designs being proposed by vendors.

The **Interfacial Area Transport Research at Purdue (THI: Thermal-Hydraulics Institute)** project will develop mechanistic models for flow patterns and their transitions that will enable more accurate modeling of conditions in boiling water reactor (BWR) rod bundles. Specifically this work will be useful in performing BWR stability calculations.

The **TRACE (TRAC/RELAP Advanced Computational Engine) Development** project is focused on developing an advanced multi-field version of TRACE to enable more accurate calculations of loss of coolant accidents (LOCAs) in uprated conventional light water reactors (LWRs) and passive plants. This new version of TRACE will provide analytical capabilities similar to those planned by vendors.

Long-term development of the **Symbolic Nuclear Analysis Package (SNAP)** user interface package will improve an analyst's ability to automatically create, execute, and analyze large sensitivity study model suites. The SNAP application interface will be extended to cover material properties so that a standardized set of material properties can be used in all analytical codes.

The goal of the **MELCOR Development** work is to improve the MELCOR code so staff can use it to support development of success criteria necessary for level 2 PRAs and analyze containment design basis and beyond design basis accidents.

In anticipation of future needs, two components of the offsite consequence code **MELCOR Accident Consequence Code System (MACCS2)** are being enhanced. The economic model and atmospheric transport and dispersion model are being upgraded to provide a greater number of parameters for uncertainty analysis.

NRC has begun **advanced reactor model development** to provide the agency with an independent safety analysis capability. The Next Generation Nuclear Plant (NGNP) evaluation model has three primary components: MELCOR, PARCS-AGREE, and SCALE/AMPX. MELCOR is the agency's severe accident analysis code that is being modified to support the system level analysis of the NGNP. PARCS is the agency's neutronics code and SCALE is the agency's cross-section generation tool.

Long-Term Research is research that is not already funded or otherwise being worked on that will provide the fundamental insights and technical information needed to address potential technical issues or identified gaps to support anticipated future (> 5 years) NRC needs. Projects in human and materials performance under this program are in place or planned for fiscal years 2009 and 2010.

Fiscal year 2009: A study of the **state-of-the-practice for PRA levels 2 and 3**. A preparatory study of **multiphase computational fluid dynamic issues**.

Fiscal year 2010: A continued review of **advanced level 2 and 3 PRA techniques**, including review of non-NRC projects. Continuation from FY 2009 of the **multiphase computational fluid dynamics** capabilities through participation in international initiatives and examination of existing codes to evaluate their strengths and weaknesses.